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(56) Documents Cited
GB 2328402 A
GB 1376003 A
US 5968624 A
US 4678690 A
GB 1500929 A
US 6042881 A
US 5322708 A

(58) Field of Search
UK CL (Edition T) B6C CBQC CGAA CGBA CGBB CGC CGD CSAC CSAD
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(54) Abstract Title
Dry ink transfer system

(57) A method of bonding an image to a surface comprises the steps of: printing an image 12 onto an image-receiving substrate 10, e.g. a transparent polyester film; applying an adhesive layer 14, e.g. a pressure sensitive acrylic adhesive, onto the image 12; securing a backing layer 16 onto the adhesive layer 14 to prevent bonding to an unintended surface; then detaching the backing layer 16 from the adhesive layer 14; placing the adhesive layer 14 in contact with the desired surface 18; and removing the image-receiving substrate 10 to leave the image 12 bonded to the surface 18. A graphic transfer sheet is also disclosed and comprises: an image-receiving substrate with a release finish 20a, 20b applied on one side; an image 12 applied to the release finish 20a,20b; an adhesive layer 14 applied to the image; and a removable backing layer 16 secured to the adhesive layer. The release finish may be a break-away coating 20a which remains in contact with the image 12 when the image-receiving substrate 10 is removed. A clear coating 30 may overly the image 12 and the surface 18.

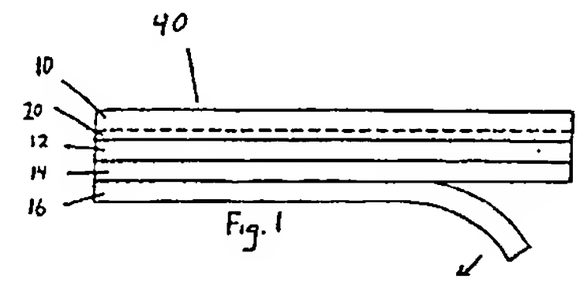

Fig. 1

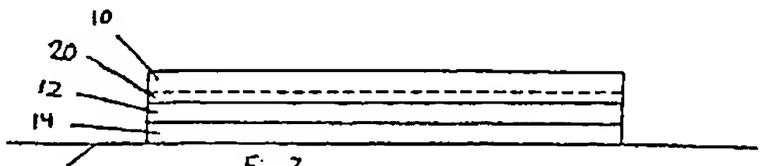

Fig 2

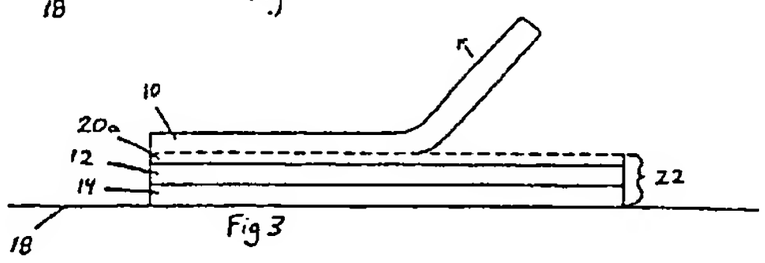

Fig 3

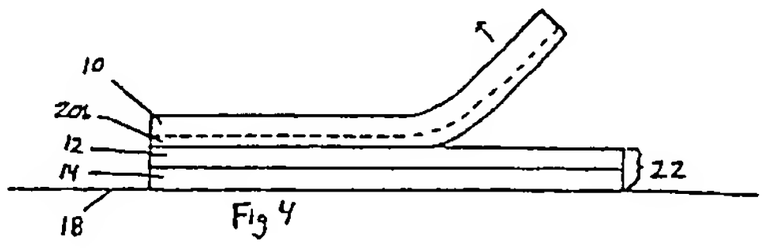

Fig 4

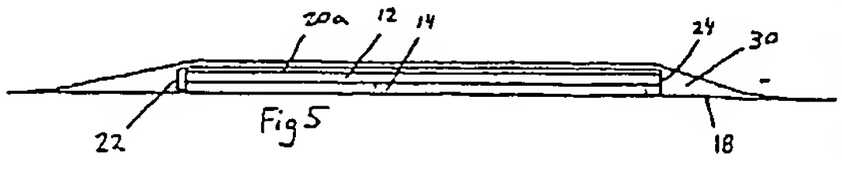

Fig 5

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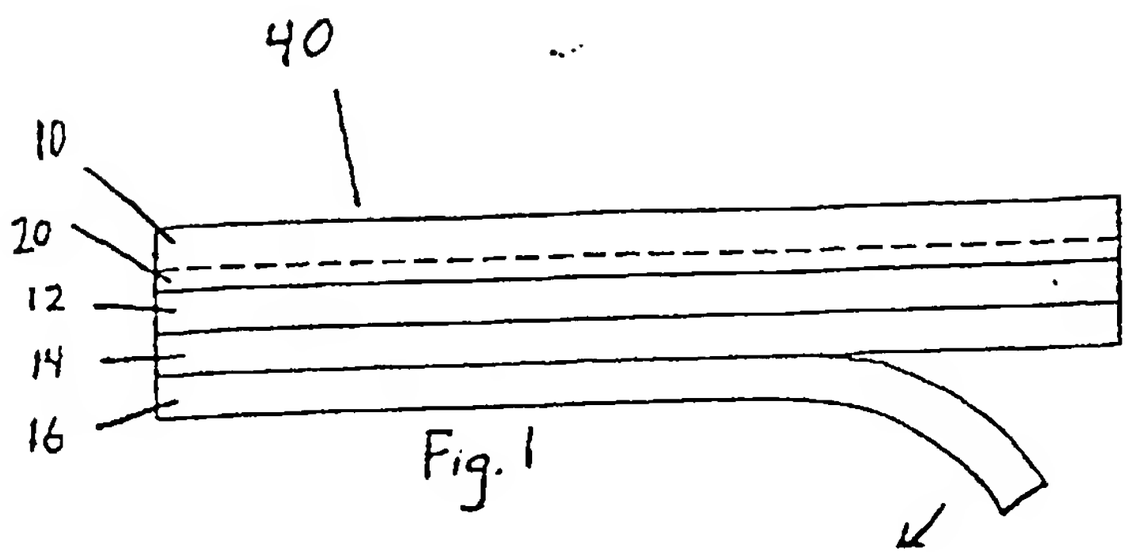

Fig. 1

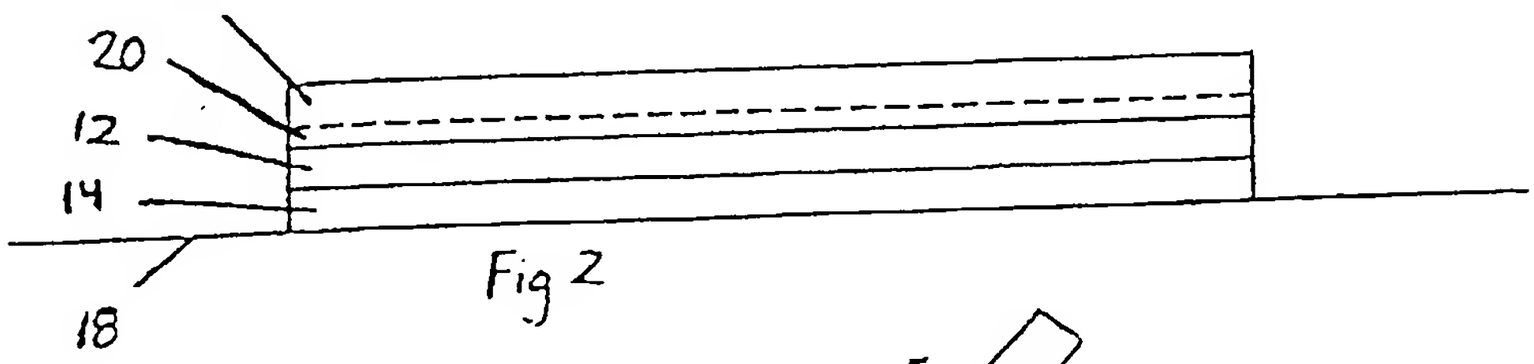

Fig 2

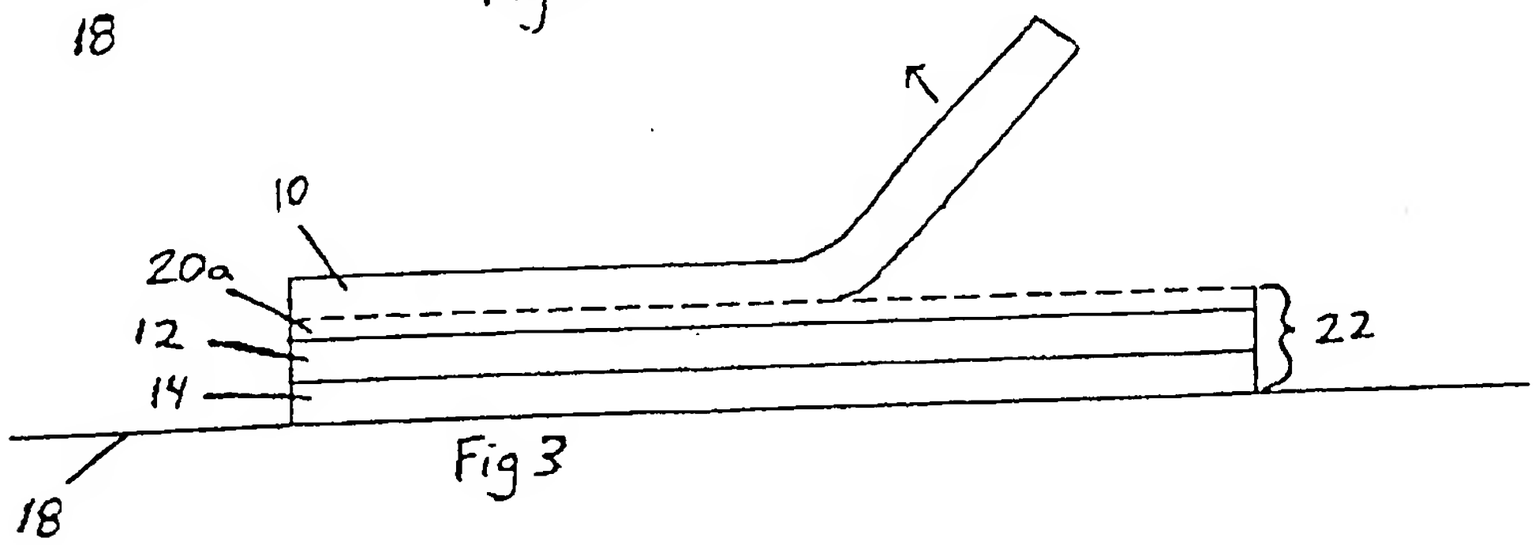

Fig 3

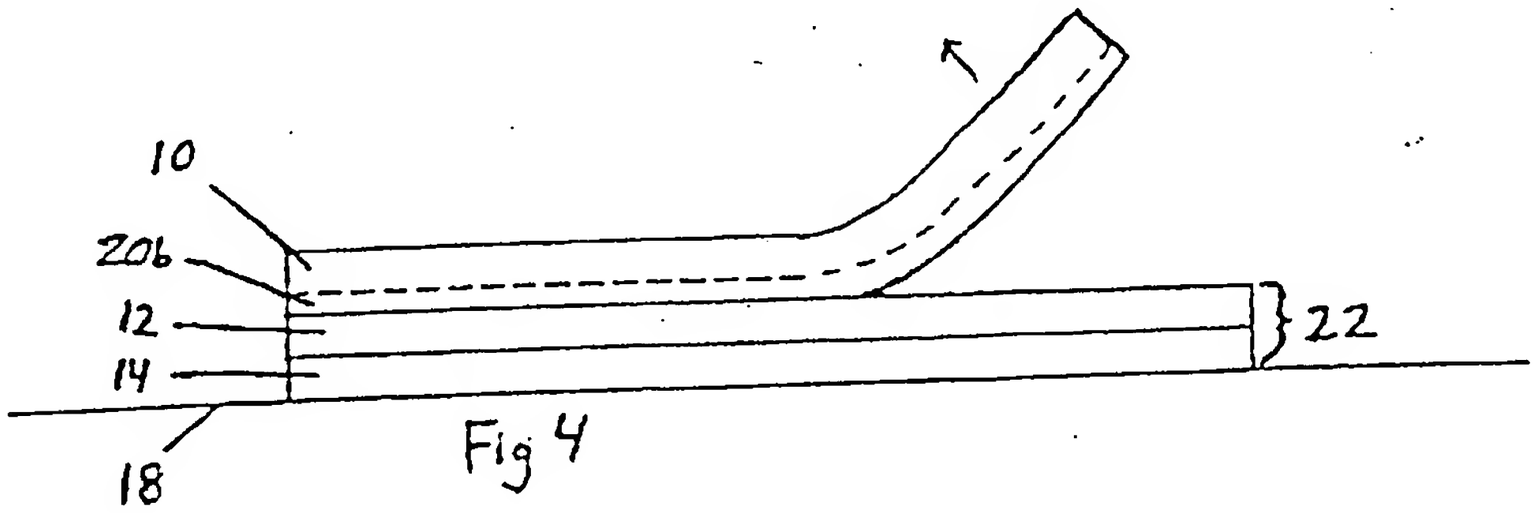

Fig 4

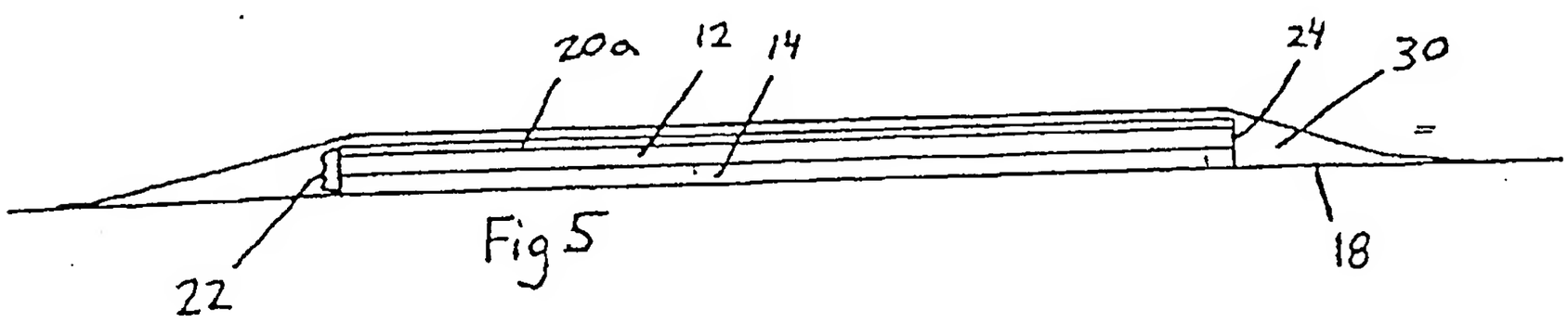

Fig 5

DRY INK TRANSFER SYSTEM

Field of the Invention

The invention relates generally to images adhered to surfaces and the application of images onto receiving surfaces, and, more particularly, to such applications using transfer sheets.

Background of the Invention

Dry transfer systems are well known in the art of transferring images. They were developed as more convenient alternatives than the prior art water slide transfer systems. The water slide transfer systems are awkward in use and difficult to store under typical atmospheric conditions.

Most of the dry transfer systems that have been developed utilize dry adhesives which are sensitive to pressure or heat. The heat-sensitive transfer sheets require additional equipment for heating the image where transfer is intended.

Dry transfer systems using pressure-sensitive adhesive often utilize a low-tack adhesive that is almost dry to the touch. Typically the bonding affected by such adhesives is weak, and the images secured thereby are easily damaged or removed by abrasion.

A typical dry transfer sheet includes a backing layer secured to a graphic-depicting material which is applied to a support substrate, often vinyl. Adhesive can be affixed to the graphic-depicting material so that the graphic adheres to the support substrate. Adhesive can also be applied to the other side of the support substrate to create a bond between the support substrate and the receiving surface, enabling transfer of the graphic-depicting material and the carrier substrate from the backing layer to the receiving surface. In such a system, the adhered image, after transfer, comprises the graphic-depicting material adhered to the support substrate, which is adhered to the receiving surface.

One problem typical of such dry transfer systems is the eventual non-adhesion of the edges of the image, and eventually the entire image, to the receiving surface due to abrasive forces repeatedly engaging the edges of the support substrate and/or the

graphic-depicting material. Though the image is provided with greater cohesive strength through the integrity offered by the support substrate, the consequent increase in the thickness of the transferred image results in a shorter life expectancy. This is due to the increased friction encountered by edges which project out farther from the receiving surface.

For instance, the surface which receives the image may be the hood of an automobile. An image at this location undergoes friction from wind, precipitation, wash mitts and chamois, as well as people who tend to pick at images secured to surfaces. Airplane and boat surfaces can encounter much higher friction forces than those encountered by automobiles.

Such images are often adhered to floor surfaces as well. In these applications, the vinyl layer supplies the image with lateral support and prevents the deterioration of the image caused by the forces associated with people and objects traveling over it. However, adhered images with raised edges inherently do not perform well under these circumstances.

Some dry transfer systems have eliminated the use of a support substrate. In other words, only the graphic-receiving material and adhesive remain bonded to the receiving surface after application of the transfer. Such systems are disclosed in U.S. Patent Nos. 3,212,913 to Mackenzie and 3,945,141 to Frost.

Mackenzie and Frost disclose dry transfer systems wherein ink forming an indicia and adhesive are transferred from a backing layer to a receiving surface upon the application of substantial pressure from behind the carrier. This transfer is accomplished through the stretching of the backing layer which loosens the bond between the ink and the backing layer and results in the ability of the adhesive to adhere the ink to the receiving surface. Mackenzie and Frost both disclose that the image adhered to the receiving surface can be easily removed by applying pressure-sensitive tape over the image and then removing the tape along with the image.

As is evident, these systems do not provide sufficient adhesion to endure the forces encountered by images on receiving surfaces such as those described above where forces much greater than that applied by pressure-sensitive tape may pull at the image.

Another problem encountered in these prior art systems is that the stretching of the backing layer necessary to affect transfer often damages or distorts the image.

In addition, because adhesion and cohesiveness have been sacrificed for thinness, the image often "bubbles" or loses adhesion to the receiving surface along its interior. This problem usually involves the deformation and stretching of the image due to friction normal or lateral to the image surface and the loss of adhesiveness. Bubbling of the image also typically occurs after a period of time in which the image is exposed to various changes in environment, such as exposure to extremes in heat and cold or exposure to humidity, water or ice. Again, such exposure is regularly encountered by the receiving surfaces addressed above.

Another problem of typical dry transfer systems deals with the application of the image to the receiving surface. Often dry transfer systems require prolonged rubbing of the back of the backing layer in order to effect adhesion between the carrier substrate and the receiving surface. For instance, in U.S. Patent No. 4,275,104 to de Nagybaczon, the film of indicia-forming material transfers to a receiving surface upon burnishing of the backing layer against the receiving surface. This burnishing deforms the indicia-forming material so that the material is pushed into the interstices of the receiving surface. While the application of repeated pressure utilized in burnishing can allow for increased adhesion, such deformation of the indicia-forming material can distort the image, especially when the image includes precise pigment distinctions or fine designs.

An improved dry transfer system which addresses these problems of known transfer systems would be an important advance in the art.

Objects of the Invention

It is an object of the invention to provide a dry ink transfer system overcoming some of the problems and shortcomings of prior art dry ink transfers.

Another object of the invention is to provide a method of transferring an image from an image-receiving substrate to a smooth surface without the necessary use of any tools which heat or provide high pressure to affect transfer.

Another object of the invention is to provide a method of transferring an image from an image-receiving substrate to a smooth surface which is efficient and easy.

Another object of the invention is to provide a method of transferring an image from an image-receiving substrate to a smooth surface wherein only the image and adhesive are bonded to the surface.

Another object of the invention is to provide a method of transferring an image from an image-receiving substrate to a smooth surface wherein the transferred image and adhesive are unsupported.

Still another object of the invention is to provide a method of transferring an image from an image-receiving substrate to a surface wherein the total thickness of the material bonded to the surface is sufficiently thin as to prevent tactile discernment of the image from the surface.

Another object of the invention is to provide a method of transferring an image from an image-receiving substrate to a surface wherein the transferred image is so strongly adhered that it can withstand high levels of friction for extended periods of time.

Another object of the invention is to provide a method of transferring an image from an image-receiving substrate to a surface wherein the user can precisely position the image onto the surface before transfer is affected.

Yet another object of the invention is to provide a method of transferring an image from an image-receiving substrate to a surface wherein the image is not deformed or otherwise damaged by the method of transfer.

How these and other objects are accomplished will become apparent from the following descriptions and the drawings.

Summary of the Invention

The new graphic transfer sheet and method of construction and use are intended to result in an extremely thin transferred image which indelibly adheres to a surface so that it cannot be removed without use of heat, solvents, or sharp tools. The method of bonding the image to a surface comprises the steps of (1) printing or otherwise applying the image onto an image-receiving substrate, (2) applying a first

side of an adhesive layer onto the image, (3) securing a backing layer to the second side of the adhesive layer so that the adhesive does not adhere to an unintended surface; (4) detaching the backing layer from the adhesive after the adhesive has been applied to the image; (5) contacting the exposed adhesive to the surface; and (6) removing the image-receiving substrate so that the image remains bonded to the surface.

The adhesive layer is comprised solely by an adhesive. The adhesive can be printed onto the image before the backing layer is secured onto it; however, in the preferred embodiment the backing layer is secured to the adhesive before the adhesive layer is laid down over the image. The method also provides that the graphic transfer sheet can be stored and/or transported after step 3, so that the sheet is ready to affect transfer whenever and wherever the user desires.

The adhesive preferably has low tackiness. Low tackiness allows the adhesive layer to be placed on the surface and moved to the intended position before light pressure is applied to the back of the image-receiving substrate to affect the contact of the adhesive to the surface. While the adhesive has low tackiness, once contacted it has a high level of adhesion to surfaces such as steel, glass, acrylics, plastics and other smooth surfaces. Its preferred adhesion can range from about 30-95 oz/in.

The low tackiness of the adhesive requires that the image transferor apply pressure to the image in order to affect contact. The low amount of pressure applied does not cause the image to deform or the image-receiving substrate to stretch. In fact, the amount of pressure necessary is so low that for small images it could be applied manually by the transferor. However, in typical large applications the transferor preferably uses a flat-ended tool such as a squeegee. The squeegee is preferred, not because of an increase in force applied, but due to the ability to apply low pressure evenly and widely so as to efficiently affect adhesion.

The image-receiving substrate is preferably a clear polymeric film, preferably polyester, and has a release-finish on the side on which the image is applied. The release-finish can be a release-coating, which remains on the image-receiving substrate when removed from the image, or a breakaway-coating, which remains on the image when the image-receiving substrate is removed. The behavior of the breakaway-

coating can better ensure that the image is not damaged by the removal of the image-receiving substrate; however, the breakaway-coating does not offer any structural support to the image.

The breakaway-coating assimilates with the image so that the presence of the breakaway-coating in the bonded composite of the image and adhesive does not substantially affect the thinness of the composite. A preferred thickness of the adhered composite (the image and adhesive) is less than about 5 mils. A more preferred thickness of the adhered composite is less than about 3 mils. A preferred thickness of the adhered composite including the breakaway-coating is less than about 5 mils. A more preferred thickness of the adhered composite including the breakaway-coating is less than about 3 mils.

The image can comprise a letter, word, insignia, design, picture or any other graphic. The image is preferably ink which is reverse-screen printed onto the image-receiving substrate so that the later application to a surface results in the correct orientation of the image. It is preferred that multi-colored images be produced from the multiple printing of different inks in succession. The image can also be comprised of non-ink pigments or dyes, as long as the image is able to attach to the image-receiving substrate, be overlaid with adhesive and be transferred to a surface without cracking or deteriorating.

The method can also include another step in which the adhered image (with or without the breakaway-coating) is coated with a clear-coat. The preferred clear-coat is a liquid which is applied to the image and a portion of the surface surrounding the image. The clear-coat acts to lessen the already nearly imperceptible edge of the adhered image so that any tactile discernment of the image from the surface is eliminated. The thickness of the clear-coat on the image is less than about 2 mils. The clear-coat is thicker on the surface adjacent to the image and tapers down to the periphery of the clear-coat so that there is no discernible edge to the image.

The surface on which the image is applied is preferably smooth, so that the unsupported adhered image lies evenly on the surface. The surface does not need to be planar because the image and adhesive layer have great flexibility in wrapping around curved surfaces. Surfaces which are sufficient for effective transfer include

vehicle surfaces, such as external and internal surfaces in automobiles, airplanes, or ships; building surfaces, such as walls, ceilings, windows, roofs, or floors; and other smooth surfaces.

Brief Description of the Drawings

FIGURE 1 is a cross-sectional view of a dry ink transfer sheet, depicting the removal of the backing layer from the adhesive layer.

FIGURE 2 is a cross-sectional view of a dry ink image applied to a receiving surface.

FIGURE 3 is a cross-sectional view of a dry ink image applied to a receiving surface, depicting the removal of the image-receiving layer with the breakaway-coating remaining on the image.

FIGURE 4 is a cross-sectional view of a dry ink image applied to a receiving surface, depicting the removal of the image-receiving layer and release-coating.

FIGURE 5 is a cross-sectional view of a dry ink image applied to a receiving surface and covered with a clear-coat.

Detailed Description of Preferred Embodiments

Referring to FIGURE 1, details of the dry ink transfer system will be set forth. The dry ink transfer system includes use of a multilayered graphic transfer sheet 40. In the preferred method of construction, the image 12 is reverse-printed onto the release-finish 20 of an image-receiving substrate 10. The image 12 is reverse-printed so that it appears properly oriented when it is applied to the surface 18. Image 12 preferably comprises diverse inks printed successively to create the intended graphic. In the preferred embodiment, the image-receiving substrate 10 is a clear polymeric film. More specifically, the preferred image-receiving substrate 10 is clear polyester. The release-finish 20 may or may not be integral to the image-receiving substrate 10. The image-receiving substrate 10 is thin, on the order of 3 to 8 mils, though its thickness is not particularly important, as long as the substrate 10 is flexible enough to enable its eventual removal from the image 12 during application to the surface 18. The release-finish 20 is typically less than about 0.6 mils thick.

An adhesive layer 14 is applied onto the image 12. In the preferred embodiment the adhesive layer 14 covers the image 12 and the exposed areas of the release-finish 20 which are not covered by the image 12. However, the adhesive layer 14 could cover only the image and not the exposed release-finish. The adhesive layer 14 is preferably a permanent pressure-sensitive acrylic adhesive. In the preferred embodiment, the adhesive is between about 0.2-1.1 mils thick.

In the preferred embodiment, the adhesive layer 14 has a backing layer 16 affixed to its back side when the front side of the adhesive layer 14 is contacted to the image 12. However, the backing layer 16 could be affixed to the adhesive layer 14 after the adhesive layer 14 is applied to the image 12. The backing layer 16 is typically smooth clear polyester with a thickness of about 0.5-4.8 mils. The backing layer 16 offers a barrier between the adhesive layer 14 and other objects so that the adhesive layer 14 does not unintentionally contact and adhere to other objects.

FIGURE 1 depicts the beginning of the removal of the backing layer 16 before the graphic transfer sheet 40 is placed on the intended surface 18.

FIGURE 2 depicts the graphic transfer sheet 40 after the backing layer 14 has been removed and the adhesive layer 14 has been contacted to the surface 18. The adhesive layer 14 is preferably low-tack. A low level of tackiness allows the adhesive layer 14 to be placed on a receiving surface 18 without immediately causing adhesion. Using low-tack adhesive, the graphic transfer sheet 40 can be moved to the preferred area for adhesion and light pressure can be applied to the top of the image-receiving substrate 10 so that the adhesive layer 14 evenly and effectively adheres to the surface 18. This light pressure can be applied manually by the user, or by utilizing a flat-ended tool such as a squeegee. In the preferred embodiment the adhesive layer 14 has high adhesion to smooth surfaces such as metals, plastics, acrylics and glass. The preferred adhesion is at least about 50 oz./in.

FIGURE 3 depicts the removal of the image-receiving substrate 10 from the adhered image 12. In FIGURE 3 the release-liner 20 is a breakaway-coating 20a which breaks from the image-receiving substrate 10 and remains on the image 12. The breakaway-coating 20a merges (not shown) with the image 12 so that the presence of the breakaway-coating 20a does not substantially affect the thinness of the adhered

composite 22. The adhered composite 22 remains bonded to the surface 18 when the image-receiving substrate 10 is removed becausc the adhesion between the adhesive layer 14 and the surface 18, the adhesion between the image 12 and the adhesive layer 14, and the adhesion between the breakaway-coating and the image 12 are greater than the adhesion between the image-receiving substrate 10 and the breakaway-coating 20a.

FIGURE 4 depicts the removal of the image-receiving substrate 10 from the adhered image 12. In FIGURE 3 the release-liner 20 is a release-coating 20b which releases from the image 12 and remains attached to the image-receiving substrate 10. The adhered composite 22 remains bonded to the surface 18 when the image-receiving substrate 10 is removed because the adhesion between the adhesive layer 14 and the surface 18 and the adhesion between the image 12 and the adhesive layer 14 are greater than the adhesion between the image 12 and the release-coating 20b.

FIGURE 5 depicts the image 12 with the breakaway-coating 20a and adhesive layer 14 adhered to the surface 18. A clear-coat 30 has been applied over the composite 22 in order to eliminate the tactile discernment of the edges 24 of the composite 22. The clear-coat 30 tapers out to a very small thickness so that tactile discernment of the end of the clear-coat 30 is impossible.

Claims

What is claimed is:

1. A method of bonding an image to a surface comprising the steps of

• printing the image onto an image-receiving substrate;

• applying a first side of an adhesive layer onto the image;

• securing a backing layer to a second side of the adhesive layer to prevent bonding of the second side to an unintended object;

• detaching the backing layer from the second side after the first side has been applied to the image;

• contacting the second side to the surface; and

• removing the image-receiving substrate to leave the image bonded to the surface.

2. The method of claim 1 wherein the securing step is performed before the applying step.

3. The method of claim 1 wherein the first side of the adhesive layer is printed onto the image.

4. The method of claim 1 wherein the image is reverse-printed onto the image-receiving substrate.

5. The method of claim 1 wherein the image-receiving substrate is a substantially transparent polymeric film.

6. The method of claim 1 wherein the image-receiving substrate is coated with a release-finish, the image being printed onto the release-finish.

7. The method of claim 6 wherein the release-finish is a breakaway-coating that remains fastened to the image when the image-receiving substrate is removed.

8. The method of claim 6 wherein the release-finish is a release-coating that remains fastened to the image-receiving substrate when the image-receiving substrate is removed.

9. The method of claim 7 wherein the total thickness of the breakaway-coating, image and adhesive bonded to the surface is less than about 5 mils.

10. The method of claim 9 wherein the total thickness of the breakaway-coating, image and adhesive bonded to the surface is less than about 3 mils.

11. The method of claim 8 wherein the total thickness of the image and adhesive bonded to the surface is less than about 5 mils.

12. The method of claim 8 wherein the total thickness of the image and adhesive bonded to the surface is less than about 3 mils.

13. The method of claim 1 further comprising the additional step of coating the image bonded to the surface with a clear-coat.

14. The method of claim 11 wherein the clear-coat is a liquid.

15. The method of claim 11 wherein the thickness of the adhered image and the clear-coat combine to substantially eliminate any tactile discernment of any edge on the surface.

16. The method of claim 1 wherein the second side of the adhesive layer has low tackiness.

17. The method of claim 1 further comprising, between the contacting and removing steps, the step of applying pressure to the image-receiving substrate to facilitate adhesion to the surface.

18. The method of claim 1, wherein the surface is a vehicle surface.

19. The method of claim 18, wherein the surface is an automobile surface.

20. The method of claim 18, wherein the surface is a airplane surface.

21. The method of claim 1, wherein the surface is a building structure surface.

22. The method of claim 21, wherein the surface is a wall surface.

23. The method of claim 21, wherein the surface is a ceiling surface.

24. The method of claim 6, wherein the image, image-receiving substrate, release-finish and adhesive layer are mutually insoluble.

25. A transferred graphic indelibly bonded to a surface, comprising a composite of an image having outer and inner sides and an adhesive secured between the inner side and the surface, and a clear-coat overlying the composite and the surface.

26. The transferred graphic of claim 25 wherein the composite has a breakaway-coating affixed to the outer side of the image.

27. The transferred graphic of claim 25 wherein the total thickness of the composite and clear-coat is less than about 5 mils.

28. The transferred graphic of claim 27 wherein the total thickness of the composite and clear-coat is less than about 3 mils.

29. The transferred graphic of claim 26 wherein the total thickness of the composite and clear-coat is less than about 5 mils.

30. The transferred graphic of claim 29 wherein the total thickness of the composite and clear-coat is less than about 3 mils.

31. The transferred graphic of claim 25, wherein the ink image is comprised of multiple inks applied in succession to create a multi-colored image.

32. A graphic transfer sheet comprising:

- an image-receiving substrate having first and second sides and a release-finish on the first side;
- an image applied to the release-finish;
- an adhesive layer affixed to the image, the adhesive layer and image having a combined thickness less than about 5 mils; and
- a backing layer secured to the adhesive layer,

whereby the graphic transfer sheet is used to transfer and secure the image and adhesive layer, substrate-free, to a surface.

33. The transfer sheet of claim 32 wherein the image-receiving substrate is a transparent polymeric film.

34. The transfer sheet of claim 33 wherein the polymeric film is polyester.

35. The transfer sheet of claim 32 wherein the adhesive is a pressure-sensitive acrylic adhesive.

36. The transfer sheet of claim 32 wherein the backing layer is smooth polyester.

37. The transfer sheet of claim 32 wherein the release-finish is a release-coating that adheres more strongly to the image-receiving substrate when the image and adhesive layer are transferred to the surface.

38. The transfer sheet of claim 32 wherein the release-finish is a breakaway-coating that adheres more strongly to the image than to the image-receiving substrate, so that the breakaway-coating remains on the image when the image is secured to the surface and the image-receiving substrate is removed.

39. The transfer sheet of claim 38 wherein the combined thickness of the adhesive layer, image and breakaway-coating is less than about 5 mils.

40. The transfer sheet of claim 32 wherein the combined thickness of the adhesive layer and image is less than about 3 mils.

41. The transfer sheet of claim 39 wherein the combined thickness of the adhesive layer, image and breakaway-coating is less than about 3 mils.

INVESTOR IN PEOPLE

Application No: GB 0212441.0
Claims searched: 1-24 and 32-41

Examiner: Barnaby Wright
Date of search: 9 September 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): B6C (CBQC, CGAA, CGBA, CGBB, CGC, CGD, CSAC, CSAD)

Int Cl (Ed.7): B41M (3/12); B44C (1/16, 1/165, 1/17)

Other: Online: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X,Y	GB 2328402 A	(TRIP INDUSTRIES) See whole document, especially page 11, line 15 to page 12, line 7, and Examples 1 and 2.	X: 1, 3-6, 8, 11-12, 17-24, 32-35, 37, 40 at least Y: 13
Y	GB 1500929	(COMBES) See especially figs. 1-4, and page 2, lines 18-65.	13
X	GB 1376003	(AVERY PRODUCTS) See especially page 1, line 61 to page 2, line 14, and page 2, lines 47-70.	32 at least
X,Y	US 6042881	(EWAN) See whole document, especially figs. 1 & 2, and col. 3, lines 54-67, and col. 4, lines 24-63.	X: 1, 2, 4, 6, 17, 32, 35, 36 at least Y: 13
X,Y	US 5968624	(LIEBE, Jr.) See whole document, especially fig. 1, and col. 2, line 50 to col. 3, line 66.	X; 1, 3-6, 8, 11, 12, 17-24, 32-35, 37, 40 at least Y: 13

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

INVESTOR IN PEOPLE

Application No: GB 0212441.0
Claims searched: 1-24 and 32-41

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Date of search: 9 September 2002

Category	Identity of document and relevant passage		Relevant to claims
X,Y	US 5322708	(EISSELE) See whole document, especially fig. 1, and col. 2, lines 6-58, and col. 5, line 36 to col. 6, line 5.	X: 1, 3, 4, 6, 8, 11, 12, 17-24, 32, 35, 37, 40 at least Y: 13
X,Y	US 4678690	(PALMER et al.) See whole document, especially figs. 1-4, and col.3, line 46 to col. 4, line 27, and col. 5, lines 22-35.	X: 1, 4-6, 8, 11, 12, 17-24, 32-35, 37, 40 at least Y: 13

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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(54) Strong flexible dry transfers

(57) A decalcamania or pressure-sensitive dry transfer is described in which a transferable design or indicium is supported on a heat-resistant flexible carrier sheet. The design is formed, at least in part, from a heat-fused plastisol ink and has a pressure-sensitive adhesive coating covering the design and extending onto the carrier sheet. An intrinsically low tack adhesive is employed which is susceptible to plasticiser migration from the plastisol, so that the adhesive tack level is increased only in the part of the adhesive which is in contact with the plastisol. In an alternative embodiment, the adhesive coating is applied first to the carrier sheet and the design printed onto the adhesive coating, the design being releasable by manipulation of the carrier sheet.

EP 0 901 910 A2

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Description

[0001] This invention relates to dry transfers having a pressure-sensitive adhesive layer on the indicia.

[0002] The need to have informative, decorative, or advertising matter on glass or other substrates has hitherto been solved by a variety of means originally by hand painting which is relatively crude and labour intensive, by using printed self adhesive materials which either have unsightly background or the obvious shape of the cut plastic or require tedious registration if punched to shape for example or by the use of pressure sensitive decals.

[0003] In the case of the latter the need to apply the adhesive in precise register with the graphics has always been a problem particularly where the graphics are extremely intricate. In the case of the most intricate small graphic elements there exists several problems with conventional self adhesive decals. With for example nitrocellulose inks used commonly for inks for such decals the strength of the ink is very limited and it is not possible to build sufficient strength in fine lines to enable the ink to be transferred easily without rupturing. If again the adhesive is printed overall and requires that the adhesive shears to enable the fine detail to be transferred without any unsightly traces of adhesive then the adhesive must be of very low tack enabling the shearing process to work. This in turn makes the receptivity to glass very poor and transfer of complex patterns very difficult indeed. The reason for the limitations found with screen process printed nitrocellulose transfer is that the mesh required to print fine definition graphics is necessarily fine and the low solids content of nitrocellulose screen printing inks exacerbates the problem of getting sufficiently thick deposits of ink to give the strength required for ease of transfer and to overcome the cohesion of the adhesive coating so that the adhesive shears accurately. Increasing the tack of the adhesives to improve transfer increases the adhesive cohesion, thus preventing effective adhesive shearing. Also, increasing the subsequent adhesion of the graphics makes removal difficult. Altogether the limitations of conventional nitrocellulose decalcamania and transfers restrict the ease of use and the graphic qualities and make ease of removal also a problem. Such decals are described in US 5,571,557 for use as a simulated glass etch.

[0004] Among other solutions proposed for this problem are the methods disclosed in US 4,820,559 in which a graphic design is printed and activated by solvent to make transfer of the design possible. In this particular example of the prior art, the difficulties of working with solvents to activate the transfer process, the time required to release solvents from between the carrier material and glass in order to develop bond of sufficient strength to overcome the bond between graphics and the carrier web, make the process difficult, tedious and time consuming.

[0005] It is the object of the present invention to overcome the problems hitherto associated with means of decorating, marking, or providing advertising images by transfer onto a range of materials, including glass, plastics, metals, wood and painted surfaces.

[0006] According to one aspect of the present invention there is provided a decalcamania which comprises a heat-fused plastisol ink supported on a heat resistant carrier sheet and having an adhesive layer on the sheet, the adhesive being in contact with the plastisol ink and the ink containing a plasticiser capable of migrating into the adhesive layer and interacting therewith to form a tacky adhesive layer in those parts of the plastisol ink in contact with the adhesive layer.

[0007] The invention also includes a method of preparing such transfers, said method comprising forming a design in a plastisol ink onto a heat-resistant flexible carrier sheet, curing the ink by heating and applying a pressure-sensitive adhesive layer over the design, said adhesive having a low intrinsic tack but being capable of interacting with plasticiser migrating from the cured plastisol ink to increase the level of tack in areas where the adhesive layer is in contact with the plastisol ink.

[0008] The steps involved in this new method involve the following:

[0009] A very strong and flexible ink is provided, which can be printed by screen process printing such that the ink is highly cohesive even when printed in fine lines. An ink which can provide these properties is described in GB Patent No. 1488487 and is a plastisol or organosol. In basic terms, the first advantage of a plastisol ink is that it contains little or no solvent so that the actual deposit printed is not significantly reduced in thickness on drying. This must be contrasted with nitrocellulose inks, for example, which normally will contain only 25-35% solids and therefore the deposit of ink possible for the same definition is only one third or one quarter of that obtainable by the plastisol ink. Hence the use of a plastisol ink provides a high solids ink (up to 100% solids) and this gives immediately three to four times the thickness of deposit compared to say nitrocellulose inks given the same screen mesh of equivalent definition. The additional strength of a plastisol ink compared to nitrocellulose inks is much higher and the elasticity considerably better. Combined with the fact that a fully cured plastisol can inherently be formulated to give many times more cohesive strength than a nitrocellulose ink the advantage of this type of ink is very evident. The plastisol inks are formulated from vinyl resins by mixing the vinyl resin powder with a suitable plasticiser. The choice of plasticiser is dependant on a number of factors, for example:

(a) some plasticisers dissolve the vinyl powders more readily than others and in some cases the plasticisers are such good solvents that some form of dissolution occurs even at room temperature. In such cases the inks are relatively unstable and after mixing, the solution of the vinyl polymer powder can cause the ink to increase in viscosity giving a

relatively short pot life. When made and used in situ this is not necessarily a disadvantage if the process can be controlled in the production of the product. On the other hand some plasticisers do not dissolve the vinyl polymer powder so readily so that the pot life of the ink is better but higher temperatures are required for the plasticiser to dissolve the vinyl polymer and form the plastisol film. The plastisol inks employed in the present invention typically contain from 45 to 100 parts of plasticiser per 100 parts by weight of the vinyl polymer. Suitable plasticisers are alkyl phthalates, e.g. dialkyl phthalates wherein the alkyl group contains from 4 to 10 carbon atoms, e.g. dioctyl phthalate. Other types of pvc plasticisers may be employed such as tricresyl phosphate, or an alkyl sulfonic acid ester of phenol (available from Bayer under the trade mark Mesamoll). One may also use in conjunction with alkyl phthalates dibutyrate esters of polyhydric alcohols, e.g. 2,2,4-trimethyl-1,3-pentyl diisobutyrate, which is available from Eastman Chemicals under the trade name Eastman TXIB plasticiser. The vinyl polymer is preferably polyvinyl chloride but copolymers of vinyl chloride with other vinyl or vinylidene monomers can be employed. Normally, a dispersion of finely divided pvc particles is formed by mixing or milling the vinyl polymer particles into the plasticiser. The plastisol ink, which may be pigmented or clear, is deposited on the heat-resistant carrier sheet, preferably by a printing process. Screen printing is convenient because thick films can be readily formed. After forming the design on the carrier, the ink is cured by heat fusing to form a homogeneous plastisol layer. Typical curing conditions are 160 to 180°C for 20 seconds to 5 minutes.

[0010] After curing the ink, a low tack pressure sensitive is deposited onto the cured design. The adhesive may be printed in register but this is unnecessary as will be explained below.

[0011] It is an observed fact that the plasticisers used to make the plastisol inks can be readily absorbed into pressure sensitive adhesives. This has been regarded in the past as a serious disadvantage, for example, in reducing the kinds of adhesives which may be selected for use in contact with highly plasticised pvc films, since the character of the adhesive is entirely changed as it picks up plasticiser from the pvc film. Consequently, adhesives of choice for applications have been those unaffected by such migration, e.g. cross-linking, water-based acrylic adhesives.

[0012] The plasticiser migration from the vinyl plastisol to the adhesive can be accelerated if the adhesive contains solvents which are mutual solvents for the adhesive system and the plasticisers used. The temperature of processing is also a contributory factor. Under normal temperature conditions the migration of plasticiser from the plastisol to the adhesive reaches a stable balance after about three days of storage. The effect of the plasticiser on the adhesive is to reduce its cohesion and increase its tack. With a basically sticky adhesive used on a very compatible plasticised plastisol the result can be to turn the adhesive into a messy fluid.

[0013] It is, therefore, normal practice to formulate adhesives for plastisols or highly plasticised pvc films such that the plasticisers are, as far as possible, incompatible with the plasticisers used, water based adhesives are used in preference to solvent-based adhesives, and cross-linking polymers are preferred as adhesives to non-cross-linked, solvent-soluble adhesives.

[0014] However, the underlying concept of the present invention is to capitalise on those factors which have hitherto been regarded as major problems and to use the effects which can be so disadvantageous to very considerable benefit.

[0015] When formulating an adhesive for use in conjunction with a nitrocellulose ink the adhesive can be designed without reference to the formulation of the ink since no migration of materials occurs from the ink to the adhesive. This means that if the adhesive is coated outside the area coated by the ink the same physical characteristics of the adhesive are maintained. A tacky adhesive which might be required to give very good adhesion to say a glass surface would therefore be tacky not only over the ink area but also outside the area of the indicia. This is undesirable since a sheet say of a number of individual designs would grab the substrate and be very difficult to manipulate. Further, the adhesive would have a comparatively high cohesive nature and would be more difficult to shear around the perimeter of the ink.

[0016] However, with a plastisol ink which provides a migratable plasticiser, the adhesive can be so designed to accommodate the migration of adhesive to change the nature of the adhesive only in the area where the adhesive is in contact with the plastisol. In this case the adhesive is formulated such that outside the indicia area it is low tack and does not grab say a glass surface and can be readily moved and manipulated on the surface whilst on the indicia. Since the indicia is exactly in register with the adhesive surface, the latter will be effectively changed to give a more tacky adhesive which adheres well to the glass or other substrate. Furthermore the adhesive being intrinsically of low tack can be formulated to shear very easily.

[0017] The result effectively of combining the use of a low tack shearable adhesive with a plastisol such that the plastisol provides a migratable component or components which can suitably modify the tack and cohesion of the adhesive is that the product has a high tack only where it is required that is in complete registration with the indicia. By manipulating the types and quantities of various plasticisers having poor to good solvency for the vinyl polymer and poor to good migratory properties together with poor to good compatibility with the dry adhesive layer the proper degree of tack and cohesion can be imparted to the adhesive.

[0018] Since the migration of plasticisers into the adhesive takes a significant period of time (approx. 3 days) the exact properties of the stabilised product cannot be immediately determined. However, having established the formulations, bearing in mind the change occurring the final formulations take the changes into consideration.

[0019] Control over the level of adhesive tack by the manipulation of both ink formulation and adhesive formulation is broadly achieved as follows:

[0020] Adhesives which are based on vinyl polymers may be selected for the purposes of the invention, since the plasticisers employed in plastisols migrate effectively into vinyl polymer films. An adhesive coated layer consisting of, say, a polyvinyl isobutyl or butyl ether, will vary in tack and cohesiveness according to the average molecular weight of the layer.

[0021] Below 30,000 average mol wt the layer will be tacky and low in cohesion.

[0022] Between 30,000 and 70,000 average molecular weight the tack becomes less aggressive and the cohesion becomes much higher.

[0023] Over 70,000 average molecular weight the tack becomes much lower and the layer is extremely cohesive.

[0024] Without altering the cohesiveness of the adhesive the tack can be further altered by adding finely divided extenders such as silica or talc which reduce the intrinsic tack further.

[0025] The migratory plasticisers used in the plastisol will migrate relative to their molecular weight into the adhesive layer and thus reduce the average molecular weight of the adhesive layer.

[0026] The balance required is achieved by increasing the average molecular weight of the adhesive layer when the plastisol contains low molecular weight plasticisers and reducing the average molecular weight of the adhesive when the higher molecular weight plasticisers are used in the plastisol ink.

[0027] An average molecular weight of say 40,000 will give a very acceptable medium tack cohesive adhesive suitable for pressure-sensitive dry transfers. A level of tack similar to that exhibited by such an adhesive would be achieved in accordance with this invention by selecting one or more polyvinyl isobutyl ethers of average molecular weight above 60,000, and using low molecular weight plasticisers in the plastisol ink which will migrate into the adhesive to give in the final decalcamania an adhesive having an average mol weight of about 40,000.

[0028] A wax may be included in the adhesive formulation to modify the tack level of the adhesive.

[0029] Plastisol inks require to be cured at temperatures between 120-180°C, preferably 140 to 180°C, for between 20 seconds and 5 minutes, preferably from 30 seconds to 1 minute. Because of this high temperature requirement it is necessary to use temporary supports which withstand this kind of temperature. Whilst it may be possible to use supports like paper or 'Teflon'-coated fabric etc. it is most practical to use polyester film.

[0030] The polyester film used would normally be between 50 and 100 microns thick to allow for ease of use during sheet fed printing operations but could be thinner, e.g. 20 to 40 or 50 microns, for reeled printing operations.

[0031] The ease of release of plastisol inks from polyester films varies depending on the characteristics of the ink and the surface of the polyester. In order to improve the release qualities of the inks the polyester film can be coated with a release agent.

[0032] It is possible to use modified silicone release agents for this purpose, but normally this is not always satisfactory since the print qualities are affected and the release of adhesive outside the indicia area is also possible. A more acceptable release coating can be produced using "Quillon" (a product of DuPont Corp.). Even this is usually too good a release coating and gives rise to problems through poor adhesion of the adhesive coating. Much more superior results are obtained by using release coatings based on cross linked epoxy polyamides or similar highly cross-linked enamel type resins such as urea or melamine formaldehyde resins. Other very satisfactory release coatings can be made from water soluble resins such as polymethyl vinyl ether/maleic anhydride resins and cellulose derivatives.

[0033] The release coating is applied to the heat-resistant flexible film using very dilute solutions of the resins to give coating weights of 0.1-2 microns. Whilst curing the polyester may mean heating the sheets or reels to temperatures in excess of 140°C, this process can be beneficially used to heat shrink the polyester to maintain more precise dimensional stability at the printing stage should this be required.

[0034] Instead of printing the adhesive over the plastisol ink design; the sequence may be reversed and an adhesive layer printed first, followed by the plastisol ink. In such an embodiment, a flexible, heat-resistant carrier sheet is coated with a release agent, e.g. the carrier sheet is a silicone treated paper. The carrier sheet, which may be in the form of a web or continuous strip, is printed overall with a low tack adhesive and dried. Indicia in a plastisol ink are then printed onto the dried adhesive layer and cured by heat fusing the plastisol. The resulting web can be coiled immediately without an intervening release sheet because neither the adhesive nor the surfaces of the indicia have any significant tack. After storage for about 2~3 days, the adhesive under the indicia will have increased in tack level because of migration of plasticiser into the portion of the adhesive coating which is sandwiched between each indicium and the siliconised paper. The indicia can then be transferred to a receptor surface, e.g. by pulling the web around an edge or corner. Because of the thickness and stiffness of the indicia, this will cause them to lift from the carrier paper, when their tacky under-surface is exposed and can be pressed onto a receptor surface. Because the adhesive outside the areas covered by the indicia has a low tack, and is relatively thin, it remains adhered to the siliconised paper surface. This embodiment is particularly suitable for printing labels.

[0035] The invention is illustrated by Figure 1 of the accompanying drawings which is a section through a dry transfer in accordance with the invention.

[0036] Referring to the drawing, a flexible carrier sheet 1 of heat resistant polymer film is preferably transparent or translucent and is coated with an adherent thin release layer 2. On the surface of the release layer one or more indicium or other design 5 is printed in a heat-fused plastisol ink. Coated over the indicium 5 and extending over the surface of the release layer is a coating of a pressure sensitive adhesive 3. This adhesive has an intrinsically low tack so that it forms a bond of low strength with a substrate. The adhesive is susceptible to plasticiser migration from the plastisol ink 5 so that, after several days storage following manufacture, the portion 4 of adhesive develops increased tack. When the surface of the portion 4 of adhesive is pressed into contact with a receptor surface, a strong bond is developed which, on manipulating the carrier sheet 1, causes the adhesive to shear around the periphery of the indicium. Thus, the indicium 5 is lifted from the carrier sheet leaving the remaining adhesive 3 attached to the carrier sheet.

EXAMPLES

Example 1

1. Polyester film 75 microns thick (e.g. Melinex film)

[0037] The film was coated with a release coating of poly methyl vinyl ether/maleic anhydride and cured at 160°C on a conveyorised belt.

[0038] Indicia were printed on the release coating at a film thickness of about 20 microns using a black vinyl plastisol ink having the following formula and cured by heating to a temperature of about 180°C in a tunnel oven for 60 seconds :

Vinyl chloride homopolymer	62.65
Dioctyl phthalate (plasticiser)	22.50
Tin based stabiliser	2.00
Carbon black	2.65
Ezsol D40 (aliphatic hydrocarbon solvent)	9.70

[0039] The indicia were letters and numerals suitable for vehicle licence plates.

[0040] An adhesive was prepared having the following formulation:

Polyvinyl isobutyl ether average mol wt 100,000	3.00
Polyvinyl isobutyl ether average mol wt 60,000	12.00
Hydrogenated ester resin (tackifier)	8.0
Finely divided Silica	2.4
Ethylene glycol mono ethyl ether	12.00
Xylene	20.00
White Spirit	42.6

[0041] The above adhesive was coated over the entire printed sheet by screen-printing and then oven dried at about 100°C.

[0042] The adhesive after drying had a very low tack but the tack developed after three days in the precise region of the indicia to give a highly tacky and cohesive film over the plastisol indicia and a low tack in the areas outside the indicia.

[0043] The indicia were protected with a silicone coated protective paper for storage prior to use. The indicia could be transferred to a glass sheet, the indicia adhering strongly to the sheet and the adhesive shearing precisely around the periphery of the indicia so that there was no border of transferred adhesive around the periphery of the transferred indicia.

Example 2

[0044] A carrier sheet consisting of 75 micron polyester was coated with polyvinyl vinyl ether/maleic anhydride solution and heated to 150-180°C to form a release layer on the carrier sheet.

[0045] The coated sheet was printed with graphics using heat set inks by the offset litho process.

[0046] A clear plastisol layer was screen printed in register with the offset litho print using the plastisol ink described in Example 1, except that the carbon black pigment was omitted and heat-fused as described in Example 1.

[0047] A pressure sensitive adhesive of non-cross-linking acrylic type was printed over the entire sheet covering the

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printed graphics. After 3 days storage, the adhesive developed a differential tack, being of high tack in the area of the printed graphics but of low tack outside. The adhesive surface was protected with siliconised paper during storage.

Example 3

[0048] A polyester sheet of 75 micron thickness was given an epoxy polyamide release coating having a dry film thickness of approximately 0.5 micron.

[0049] A design in a clear plastisol ink containing mica and silica extender was printed on the release coating to give an etched glass appearance. The plastisol ink was cured as described in Example 1.

[0050] An adhesive as described in Example 1 was applied over the sheet so that it covered the design. A differential adhesive tack was developed with the adhesive on the plastisol ink exhibiting a high surface tack and the surrounding adhesive having a very low surface tack. The resulting decalcamania could be used to transfer lettering or other design to a window, and simulated the appearance of an etched glass design. The adhesive sheared precisely around the design and no adhesive transferred with the design.

[0051] Other variations may be made in the preparation of transfers in accordance with the invention. For example, other release coatings may be used such as melamine-formaldehyde coatings. A variety of effects may be achieved, e.g. by screen printing normal vinyl or other inks over the plastisol ink. Interesting effects may be secured where the plastisol ink is formulated to give an etched glass appearance (as in Example 3) or is a white pigmented plastisol ink and additional designs are overprinted. Tinted clear plastisol inks may also be employed.

[0052] Any of the conventional printing methods can be used to apply the plastisol or other inks, including using digital laser printers.

[0053] There are many uses for the transfers of this invention, including for application to glass as a resist for sand-blasting and for manufacture of number plates.

Claims

1. A decalcamania which comprises a heat-fused plastisol ink supported on a heat resistant carrier sheet and having an adhesive layer on the sheet, the adhesive being in contact with the plastisol ink and the ink containing a plasticiser capable of migrating into the adhesive layer and interacting therewith to form a tacky adhesive layer in those parts of the plastisol ink in contact with the adhesive layer.

2. A decalcamania as claimed in claim 1 wherein the plastisol ink is printed on said carrier sheet and forms indicia thereon.

3. A decalcamania as claimed in claim 1 or 2 wherein the carrier sheet has a release layer, the plastisol ink being supported on this release layer.

4. A decalcamania as claimed in any one of the preceding claims wherein the plastisol ink is pigmented.

5. A decalcamania as claimed in claim 1 wherein indicia, which are formed in a non-plastisol ink, are supported on said carrier sheet and said indicia carry an adhesive layer, the adhesive layer extending over the plastisol ink layer.

6. A decalcamania as claimed in claim 5 wherein the adhesive layer is printed in register with said indicia.

7. A decalcamania as claimed in claim 5 or 6 wherein the plastisol ink layer is a clear plastisol ink layer.

8. A decalcamania as claimed in claim 5 wherein the adhesive comprises a polyvinyl isobutyl ether.

9. A decalcamania as claimed in claim 8 in which the adhesive contains a solvent which is a solvent for the plasticiser in the plastisol ink.

10. A decalcamania as claimed in any one of claims 1 to 4 wherein a low tack adhesive forms a layer on the carrier sheet and the plastisol ink is printed onto the adhesive layer so that adhesive between the ink and the carrier sheet is rendered tacky by migration of plasticiser from the plastisol ink.

11. A decalcamania as claimed in claim 10 wherein the carrier sheet is a web whose surface has been treated or coated with a release agent and indicia in a plastisol ink are printed onto said surface.

12. A method of manufacturing a dry transfer which comprises forming a design in a plastisol ink onto a heat-resistant flexible carrier sheet, curing the ink by heating and applying a pressure-sensitive adhesive layer over the design, said adhesive having a low intrinsic tack but being capable of interacting with plasticiser migrating from the cured plastisol ink to increase the level of tack in areas where the adhesive layer is in contact with the plastisol ink.

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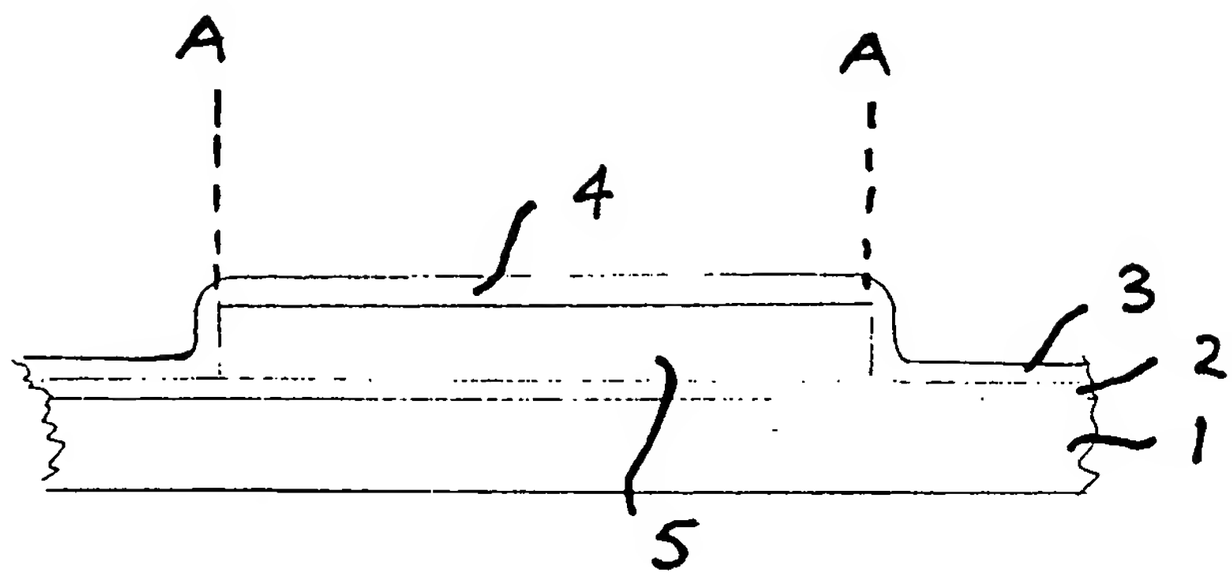
Fig 1



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(54) Strong flexible dry transfers

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 30 6660

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A	US 5 571 557 A (DE BASTIANI NORMAN P ET AL) 5 November 1996 (1996-11-05) * the whole document *	1	

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B44C
B41M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 January 2002	Pineau, A

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 30 6660

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US006136127A

United States Patent [19]

De Bastiani

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[45] Date of Patent: Oct. 24, 2000

[54] ELECTRICALLY CONDUCTIVE ADHESIVE TRANSFERS

[75] Inventor: **Norman P. De Bastiani**, S. Hadley, Mass.

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[58] **Field of Search** ..... 156/230, 233, 156/237, 238, 239, 240, 241, 247, 277, 289; 428/914; 427/146, 147, 148; 200/5 A

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[57] **ABSTRACT**

An electrically functional adhesive transfer for use in the manufacture and/or the design of flexible membrane circuits. Electrical circuit elements, instead of being printed directly upon polyester film substrates, are printed upon a carrier sheet. A pressure sensitive adhesive is applied over the exposed surfaces of the printed circuit pattern on the carrier sheet and covered by a release paper. The circuit later is applied to any desired substrate by peeling away the release paper and mounting the circuit by means of the pressure sensitive adhesive. The carrier sheet typically is peeled away after the circuit is adhesively bonded to the substrate. The carrier sheet desirably is transparent or translucent in order to facilitate visual alignment of the circuit pattern with the substrate to which it is being bonded.

4 Claims, 1 Drawing Sheet